METHODS AND CONFIGURATION TO SIMPLIFY CONNECTIONS BETWEEN POLYSILICON LAYER AND DIFFUSION AREA

This application claims priority to a pending U.S. provisional patent application entitled METHODS AND CONFIGURATION TO SIMPLIFY CONNECTIONS BETWEEN POLYSILICON LAYER AND DIFFUSION AREA, filed October 23, 2002 by Jeng-Jye Shau as the sole inventor of this Application and accorded a Serial No. 60/420,884, the benefit of its filing date being hereby claimed under Title 35 of the United States Code.

BACKGROUND OF THE INVENTION

Field of the Invention:

The present invention relates to integrated circuit (IC) manufacture procedures, and more particularly to methods for connecting poly-crystal silicon (poly) layer and diffusion area.

Descriptions of Related Arts:

FIG. 1(a) shows the top view for an example of current art poly-to-diffusion connection (PDC). A diffusion contact (108) is placed on top of diffusion area (103). A poly contact (109) is placed on top of poly (105) area. These two contacts (108, 109) connected by a metal layer (107). The cross section view of the structure in FIG. 1(a) is shown in FIG. 1(b). The poly layer (115) on field oxide (110) is connected to the diffusion area (113) through a poly contact (119), a metal layer (117), and a diffusion contact (118).

The dimension of such PDC is limited by many design rules. There is a design rule limiting the poly-to-diffusion distance (Dd-p), a design rule limiting the poly contact to diffusion distance (Dd-c), and a design rule limiting the contact to contact (Dc-c) distance as shown in FIG. 1(a). In the conventional techniques of integrated circuit designs, these design rules are originally required for the purpose of preventing accidental shorts between the poly and the diffusion areas. However, these design

rules are still imposed and employed for designing IC circuits even under the circumstances that the circuit design is intended to connect the poly and diffusion areas. In the conventional techniques of IC design, these rules are still used even that those design rules are not meaningful as exemplified by a circuit as that shown in Fig. 1A and 1B. In order to meet those design rules that are required for other purposes, current art PDC is highly inefficient. For many integrated circuits, especially for tightly pitched layout circuits, such limitations caused increase in overall layout area. It is therefore desirable to develop an efficient PDC structure to remove those constraints.

SUMMARY OF THE INVENTION

The primary objective of this invention is, therefore, to reduce the areas of poly-to-diffusion connections. The other primary objective of this invention is to reduce the resistance of PDC. Another objective is to achieve said simplification without changing current art IC manufacture procedures.

These and other objects are accomplished by novel structure that using a single contact to form PDC.

While the novel features of the invention are set forth with particularly in the appended claims, the invention, both as to organization and content, will be better understood and appreciated, along with other objects and features thereof, from the following detailed description taken in conjunction with the drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1(a) is the top view of a prior art PDC;

FIG. 1(b) shows the cross-section structures of the prior art PDC in FIG. 1(a);

FIG. 2(a) is the top view for a PDC of the present invention;

FIG. 2(b) shows the cross-section structures of the PDC in FIG. 2(a) after contact etching procedure;

FIG. 2(c) shows the final cross-section structures of the PDC in FIG. 2(a);

FIG. 2(d) is the top view for a PDC of the present invention that does not use metal layer;

FIG. 2(e) shows the cross-section structures of the PDC in FIG. 2(d) after contact etching procedure;

FIG. 2(f) shows the final cross-section structures of the PDC in FIG. 2(d);

FIG . 3(a) is the top view for a PDC of the present invention that has a rectangular contact; and

FIG. 3(b) shows the cross-section structures of the PDC in FIG. 3(a).

DETAILED DESCRIPTION OF THE INVENTION

FIG. 2(a) shows the top view for one example of a PDC of the present invention. In this example, the poly area (205) is extended into the depletion area (203). A contact (208) is placed covering both the poly (205) and depletion (203) areas. The connection is therefore formed by a single contact (208). FIG. 2(b) shows the cross section structures of the PDC in FIG. 2(a) after contact etching procedures have been done. A contact opening (210) is opened covering both the poly area (215) and the diffusion area (213). The contact etching procedure will remove the insulating layers while stopping on silicon. Since both the poly and the diffusion areas are made of silicon, both areas will be exposed after the contact etching procedures as shown in FIG. 2(b). The following contact forming procedures will fill the contact opening (210) in FIG. 2(b) and

form a direct connection between diffusion and poly as shown in the cross section diagram in FIG. 2(c).

The PDC of the present invention uses only one contact. Its area is therefore much smaller than prior art PDC in FIG. 1(a). No changes in IC manufacture procedures are needed to support the structure in FIG. 2(a). Therefore, there is no additional cost to support such connection structures.

While specific embodiments of the invention have been illustrated and described herein, it is realized that other modifications and changes will occur to those skilled in the art. For example, different contact filling materials can be used to assure better connections. Different contact etching procedures also can have similar effects. In the above example, the shared contact (208, 218) is connected to metal layer (207, 217) so that other structures also can be connected to this PDC using metal connections. When there is no need to connect this PDC to other structures, there would be no need for such metal connection. FIG. 2(d) shows the top view of a PDC of the present invention that uses a contact without metal connection. FIG. 2(e) and FIG. 2(f) are cross section views of the structures in FIG. 2(d). Such PDC that does not use metal layer further optimize the area efficiency of PDC.

One potential problem for the above PDC structure is the possibility for the contact to miss diffusion or poly layer due to mis-alignment of the contact. A simple solution is to elongate the contact area as shown in FIG. 3(a). In this example, the contact (308) is elongated vertical to the poly/diffusion edge to assure sufficient connections. The cross section view of such contact (318) is shown in FIG. 3(b).

The above examples assume that the PDC contacts of the present invention are formed in the same time as other metal contacts for cost-saving reasons. It is certainly an option to use separated contact etching procedures specifically to form PDC contacts of the present invention. Using separated contact forming procedures will increase manufacture

costs, but in will allow other options. One example is to use poly silicon as the contact filling materials (218, 258, 358). It is also possible to further optimize the area of PDC contacts using separated manufacture procedures.

The present invention provides novel contact structures to achieve significant area reduction for PDC. While specific embodiments of the invention have been illustrated and described herein, it is realized that other modifications and changes will occur to those skilled in the art. It is therefore to be understood that the appended claims are intended to cover all modifications and changes as fall within the true spirit and scope of the invention.